Chapter A3: Aquatic Organisms Other than Fish that are Vulnerable to CWIS

INTRODUCTION

Chapter A2 focused specifically on fish species. Fish are of particular concern in the context of § 316(b) because of their importance in aquatic food webs and their commercial and recreational value. However, numerous others kinds of aquatic organisms are vulnerable to cooling water intake structures (CWISs), including diverse planktonic organisms, macroinvertebrates such as crabs and shrimp, and aquatic vertebrates such as sea turtles. These other organisms are discussed briefly in this chapter based on information compiled for EPA's § 316(b) rulemaking activities (SAIC, 1995).

CHAPTER CONTENTS

A3-1 PLANKTON

Plankton includes microscopic organisms, plant or animal, that are suspended in the water column and are neutrally buoyant. Because of their physical characteristics, most planktonic organisms are incapable of sustained mobility against the flow of water. Consequently, plankton drift passively in prevailing currents and have limited ability to avoid CWIS.

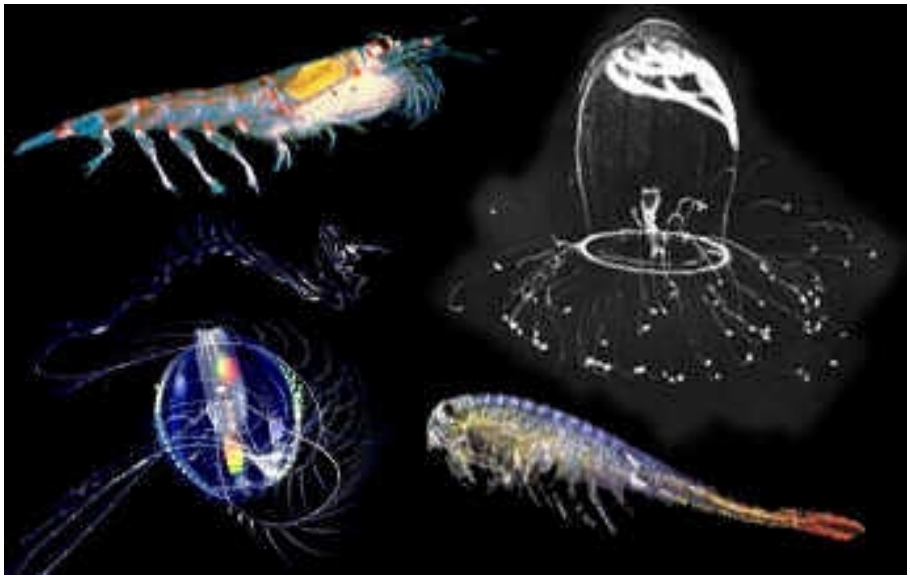
A3-1.1 Phytoplankton

Phytoplankton are free-floating plants, usually microscopic algae, which are primary producers in many aquatic environments. Primary productivity can be reduced by passage of phytoplankton through CWIS, especially during summer. In warm climates, a greater portion of the year may be affected. Some plants in lower latitudes may decrease primary productivity to some extent throughout the year.

Losses of phytoplankton rarely occur beyond the immediate vicinity of the CWIS. Possible exceptions include areas where mixing within non-entrained water is limited or slow, such as in enclosed bays or waters where substantial portions of water are withdrawn for cooling. In these cases, the effects of entrainment on algal primary productivity and biomass may persist and be apparent beyond the vicinity of CWIS.

A3-1.2 Zooplankton

Zooplankton are free-floating planktonic animals. Most zooplankton species have relatively short population regeneration times (from days to weeks), and therefore zooplankton populations are able to recover from entrainment losses relatively rapidly.



Source: USGS, 2001a

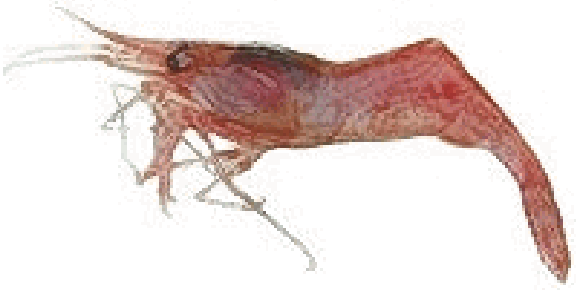
A3-1.3 Ichthyoplankton

Ichthyoplankton includes egg and larval stages of fish species. When egg and larval stages are pelagic, vulnerability to entrainment is relatively high. In contrast, eggs that are demersal and attach to plants or sediments are rarely entrained.

A3-2 Macroinvertebrates

Macroinvertebrates are invertebrate organisms that are large enough to be seen with the naked eye. Macroinvertebrates include many familiar crustaceans, such as lobsters, crayfish, crabs, shrimp, and prawns. Such organisms live in sediments, the surface of sediments, hard surfaces (e.g., rock pilings), or the water column itself. It is not uncommon for macroinvertebrate species to use different habitats at different parts of their life cycle. Macroinvertebrates such as shrimps are quite mobile and capable of moving throughout the water column in large schools, increasing their susceptibility to I&E. On the other hand, crabs and lobsters live on the bottom and typically do not swim in the water column. However, early life stages of these species are frequently planktonic.

Comparatively few studies have been devoted to CWIS effects on macroinvertebrates. Available information suggests that macroinvertebrates with hard exoskeletons (e.g., blue crab) have relatively high survival rates following impingement. However, molting individuals are often found dead in impingement samples. Sessile adults of species such as clams and oysters are not typically entrained. However, because such species are often broadcast spawners with planktonic egg and larval stages, population abundance can be reduced by CWIS. In addition, because many macroinvertebrates serve as important prey items for many freshwater and marine fishes, declines as a result of CWIS can adversely affect aquatic food webs.



Source: NOAA, 2002b.

Source: NOAA, 2002c.

A3-3 Sea Turtles and Other Vertebrate Species

CWIS effects on vertebrates in aquatic environments are of greatest concern for sea turtles, including several species that are currently state- or federally-listed as threatened or endangered. Sea turtles, seals, and other aquatic vertebrates can die if they are drawn into intakes or are impinged on intake screens.

Source: NMFS, 2001e

A3-4 CONCLUSIONS

Although most I&E studies focus on fish species, it is important to bear in mind that many other kinds of aquatic organisms are vulnerable to I&E, either during early development or throughout their life cycle, depending on factors such as size, swimming ability, reproductive strategy, and other life history characteristics.

It is also important to note that in addition to direct harm from I&E, most aquatic organisms are also susceptible to indirect impacts as a result of the impingement or entrainment of prey items. Unfortunately, few studies consider how CWIS impacts may disrupt aquatic food webs (however, see Summers, 1989).

In addition, although indirect effects on fish species whose prey are impinged or entrained are generally acknowledged, there has been little consideration of indirect effects of CWIS on non-fish species. In an effort to address this knowledge gap, Chapter A4 discusses CWIS effects on bird species.